ACMES

Advanced Climate Modeling and

Environmental Simulations

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AFCCC/DOMM (AFWA)

Outline

- Background
- Products
- Computational Resources
- Future Plans

AFCCC Mission

Collect, maintain, and apply worldwide weather
data, creating climatological products to
strengthen the combat capability of

Background

Requirements:

- Observational quality data
  - Located at any point
  - Summarized statistics
- Support for many phases of operations
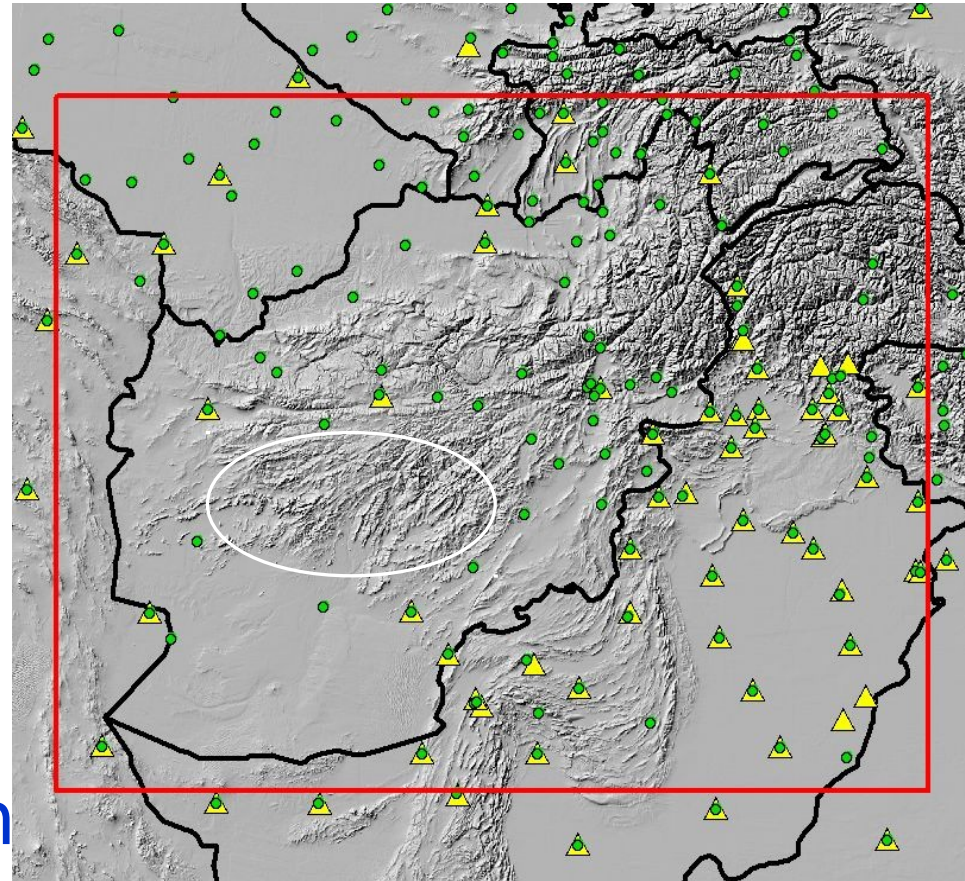 - Simulations
  - Planning and execution

Background - AFCCC Products

- Observational data are not evenly spread over the globe.
    - Approximately 10,000 active reporting sites worldwide
    - Location and data counts vary widely
    - Surface observation sites per continent:
        - South America ... ~ 600   -Africa ..... ~ 800
        - North America ... ~ 2250   -Asia ...... ~ 3100
        - Antarctica .... ~ 50   -Europe ... ~ 3150
        - Australia .... ~ 750
    - Oceans
- Average separation: 200 km
- Marginal data quality

Background

- Poor data availability
  - Oceans
  - Mountains
  - Deserts

- Lack of certain data elements
  - Turbulence & icing
  - Snow

- Non-standard reportin practices

🟢 OCDS Station database
🔺 GHCN Station database

Background

Solution: Model Simulation Strategy

• Gridded climatological fields provide a surrogate source of data at times and places where real data is not available.

• This data is physically consistent with the known 4-D state of the atmosphere, but with a greater spatial and temporal resolution.

Background

What ACMES is <u>not</u>:

- A prediction for a specific (e.g. next fall) time
- A predictor of climate change

Background

Dynamic Mesoscale Model

- Run 15hr forecasts for a long period of record (10 years)

- Input external climatological databases, NCAR Reanalysis, surface, and rawinsonde data

- Output model data every hour

- Resolution: 40, 10, and 5km at multiple levels

- Post-process hourly output data into climatological statistics

Products

- POR capable 1973 - 2001 (currently 1986 - 1996)

- Dozens of regions generated at 40 and 10km resolution
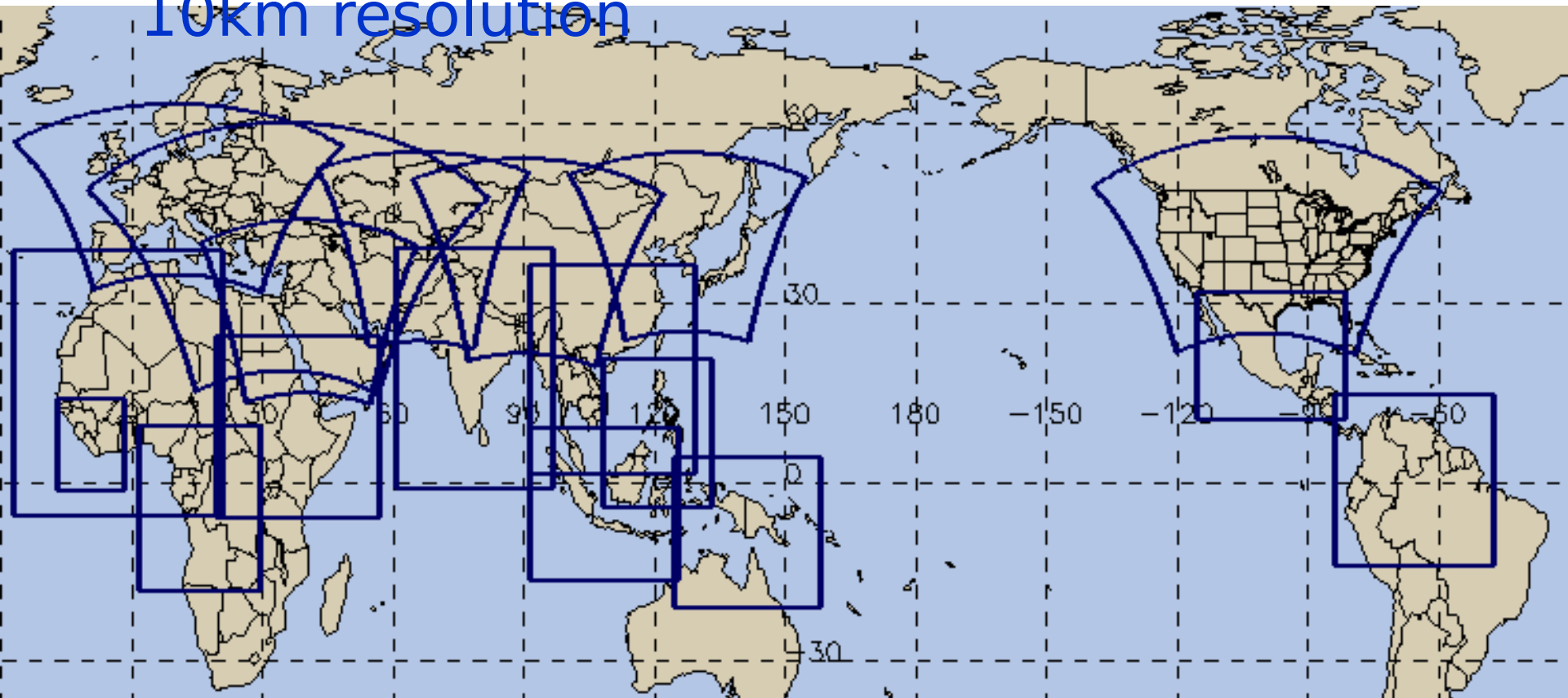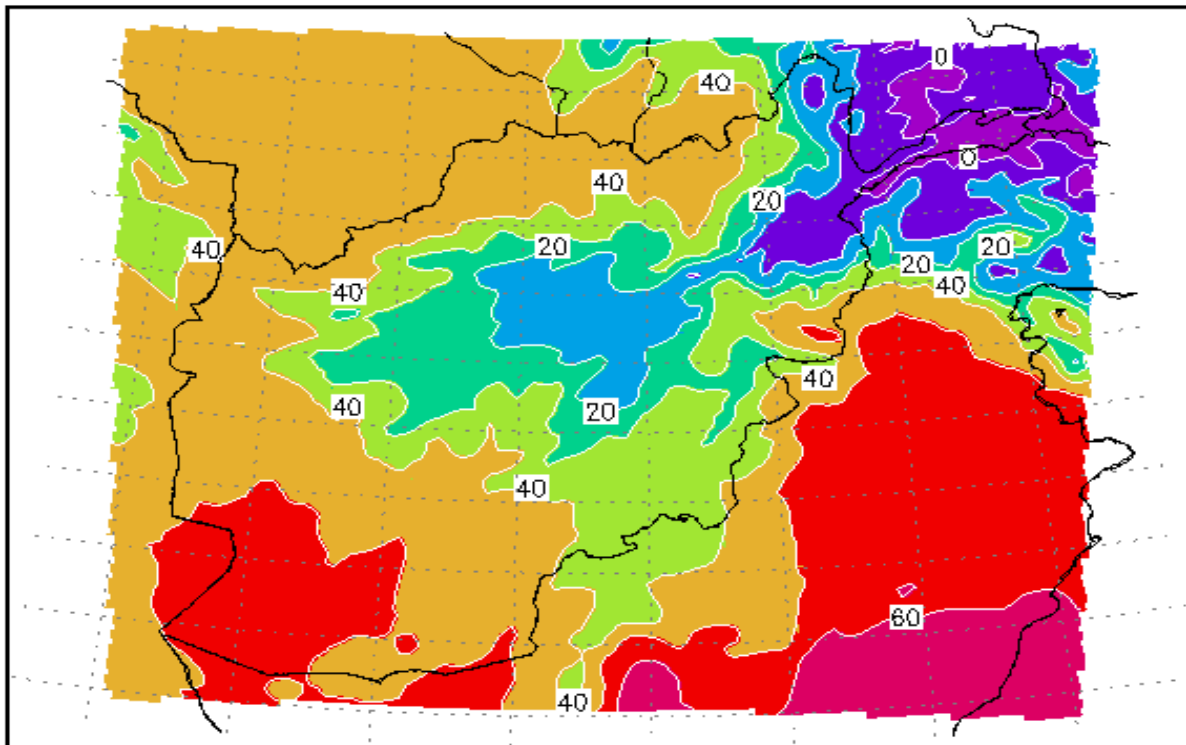
Products

- Two basic support types
  - Routine ACMES climatologies
    - Regional – 2D gridded data and graphics
    - Point -- simulated OCDS reports
  - Just-in-Time ACMES scenarios
    - Recreate weather events on-demand
    - 4D gridded environmental data

Products

- ## Sample 2-D Visualization:

ACMES Modeled Climatology

Dec
POR: 1986 — 1995

Mean Surface Temperature
Units: F
Hour Count: 7440

AFCCC/DOC1 (AFWA)
151 Patton Ave, Rm 120
Asheville, NC 28801-5002
http://www2.afccc.af.mil

Visualized using GrADS: COLA/IGES
http://grads.iges.org/grads/

0   10   20   30   40   50   60

Products - Web Interface

File   Edit   View   Favorites   Tools   Help

Address https://www.afccc.af.mil/acmes_mil1/cgi-bin/ACMESviewer.pl?REGION=Afghanistan+%2811km%29&MONTH=Jai   Go

Back   Search   Favorites

ACMES PRODUCT VIEWER

REGION	MONTH	PARAMETER	
Afghanistan (11km)	January	Temperature	Update

Afghanistan (11km)		January		Temperature		
Variable	**HOURS (00 - 23Z)**				**All Hours**	**LOOP**
Freq Temp < 0F	00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23				ALL	Hourly Monthly
Freq Temp < 32F	00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23				ALL	Hourly Monthly
Freq Temp > 90F	00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23				ALL	Hourly Monthly
Max Surface Temperature	00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23				ALL	Hourly Monthly
Mean Daily Max Temperature	-- --				ALL	----- Monthly
Mean Daily Min Temperature	-- --				ALL	----- Monthly
Mean Surface Temperature	00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23				ALL	Hourly Monthly
Min Surface Temperature	00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23				ALL	Hourly Monthly
Std Dev of Daily Max Temp.	-- --				ALL	----- Monthly
Std Dev of Daily Min Temp.	-- --				ALL	----- Monthly
Std Dev of Sfc Temperature	00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23				ALL	Hourly Monthly

OPR: AFCCC/DOC1

Computational Resources

- AFCCC Local Network
  - Sun Ultra 60 as Master
  - 10 Intel PCs with 2 (1GHz) CPUs Each
  - 10 Intel PCs with 2 (2GHz) CPUs Each
  - 1 Intel PC "Development" unit with 2 (1GHz) CPUs
  - 3 Intel PC "Miscellaneous" units with 2 (550-733 MHz) CPUs
  - About 3TB of Total Disk Storage Space
  - Gigabit internal communications
  - All Data Storage Online--Databases and Output

Computational Resources

- High Performace Computing (HPC) centers
  - ASC MSRC: Wright-Patterson AFB, OH
  - ERDC MSRC: Vicksburg, MS
  - ES-40/45 systems similar in speed to 1 GHz system at AFCCC
  - Parallel processing not currently exploited

Future Plans

- Weather Research and Forecast (WRF) model
    - Next generation of NWP (NCEP,NCAR,AFWA)
    - Unite modeling efforts with AFWA
    - Use parallel computing environment
    - Contribute to the modeling community

Future Plans

- Validation and Verification
  - Overdue quality assessment
  - Provide users with level of uncertainty
  - Skill indications from data rich areas may be used to infer accuracy in those lacking data

Future Plans

- Interactive Graphics
  - Similar to AFWA's IGrADS
  - Eliminates generation of 28,000 gifs/region
  - User may select graphics properties

Step (1) — Region and Parameter Selection

	Region	Parameter	
Region and Parameter Selection Matrix	CONUS (40km) / Iraq (11km)	Temperature / Dew Point	Update

Step (2) — CONUS (40km) Isopleth Analysis

	Month(s)	Temperature Variables	Map Parameters
Monthly Statistics Selection Matrix (Multi-Month)	January / February / March / April	Freq Temp < 0F / Freq Temp < 32F / Freq Temp > 90F / Max Surface Temperature	Black ⦿ White ○ Page Loop

OR — CONUS (40km) Isopleth Analysis

|	Month/Hour(s)	Temperature Variables	Map Parameters
Hourly Statistics Selection Matrix (Multi-Hour)	January / 01 02 03	Freq Temp < 0F / Freq Temp < 32F / Freq Temp > 90F / Max Surface Temperature	Black ⦿ White ○ Page Loop

OR — CONUS (40km) Single Point Analysis (Plot XY Graph)

	Latitude (21.8 to 57.0)		Temperature Variables	Map Parameters
	Tens:	Units:	Monthly (All Months)	Black ⦿ White ○
	20	0	Freq Temp < 0F	

Future Plans

- Global Climatological Dataset
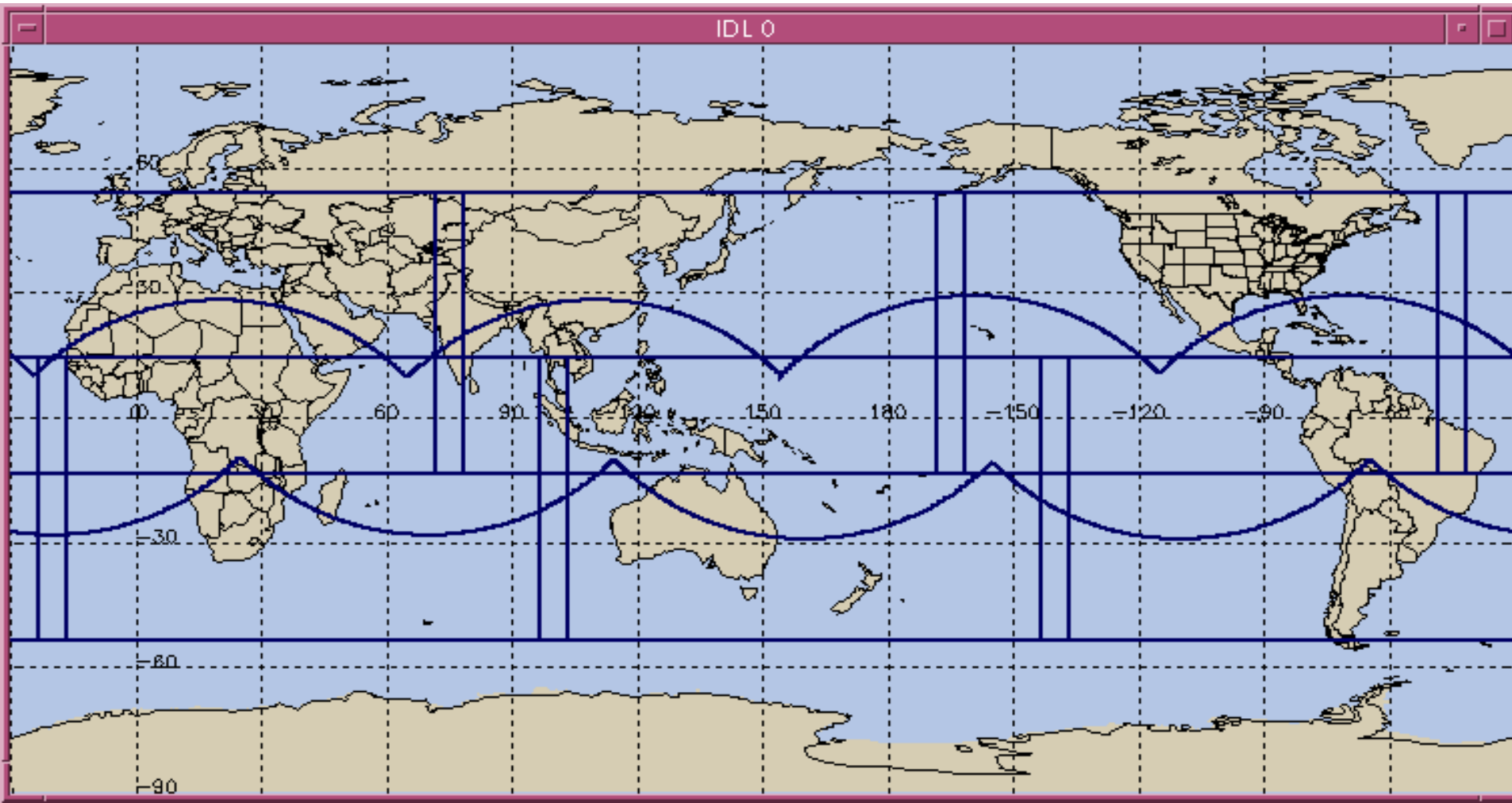
More Ideas

- Longer period of record
  - El Niño stratification, trends
- Computing Environment
  - Migrate from Solaris to Linux
  - Parallel computing
- Mountain Wave Forecast Model
- Derived soundings from satellites for input

More Information

https://www.afccc.af.mil/acmes_mil1/index_mil.html

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